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The Road to Reducing Dementia Onset and Prevalence: Are diet and physical activity interventions worth investing in?

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Table of Contents

Executive summary ii

1 Introduction 1

1.1 What is the problem? 1

1.2 Why is this relevant to policymakers? 1

1.3 Aims 4

2 What does the research tell us? 5

2.1 Number of people affected and future projections 5

2.2 The effect of delaying onset of dementia 5

2.3 Evidence in support of modifiable lifestyle changes 6

2.3.1 Brain risk factors (mental and social activity) 7

2.3.2 Body risk factors (diet, physical activity, alcohol intake) 7

2.3.3 Heart Risk Factors (blood pressure, body mass index, cholesterol, diabetes, smoking) 10

3 Why highlight diet and physical activity interventions? 12

4 What works? 13

5 What should policymakers do? 17

6 References 21

7 Appendix 1: The checklist of good characteristics for healthy diet and physical activity 32

8 Appendix 2: Excerpt on older adults from WHO publication 'Interventions on diet and physical activity – what works' (2009) (70) 33

9 Appendix 3: Examples of physical environment modification approaches that can be carried out by local government 43

Executive summary

In Australia, deaths as a result of dementia have now taken over cerebrovascular disease as the second leading cause of death. At present, over a quarter million Australians suffer from dementia and projected estimates indicate that the figure can reach a high of nearly one million by 2050.

Diet and physical activity have been shown to promote brain health and offer some protection against cognitive decline. Moreover, they have also been recognised as risk factors for developing other conditions such as cardiovascular disease, diabetes, hypertensive diseases and certain cancers all of which are leading causes of death in Australia.

Research shows that higher ratios of saturated fat to monounsaturated fats are predictive of negative mental function. In addition, high mid-life serum cholesterol levels and excessive caloric intake have been found to be associated with impaired cognitive function. Increased intakes of fish, vegetables and legumes, antioxidant rich foods and adequate amounts of certain B-vitamins have been reported to have a protective brain effect.

Increased levels of physical activity have been found to promote neuro-protective changes in the hippocampus of the brain – a region central to learning and memory. This brain region is one of the first areas affected by dementia. Most studies have demonstrated that a high level of physical activity in adults with no dementia is associated with a 30% to 50% reduction in the risk of cognitive decline and dementia. Some studies have also theorised that poor physical function may precede the onset of dementia and Alzheimer's disease and higher levels of physical function may be associated with delayed onset. Results from the Australian Bureau of Statistics National Health Survey (2011 – 2013) show that many Australian adults do not meet the National Physical Activity Guidelines (to do at least 30 minutes of moderate intensity physical activity on most days) as more than half the population is inactive. Further, two-thirds of Australians are now overweight/obese and a large proportion of total energy consumed comes from foods considered to be of little nutritional value. An intervention that focuses on improving diet and physical activity habits therefore has the ability to produce inestimable benefits.

There are many factors that must be considered when developing a successful diet and physical activity intervention. These span a gamut of issues from carefully defining the target audience, utilising a multidisciplinary approach, tailoring content and materials, determining forms of delivery and identifying specific behaviour change techniques to determining financial costs in relation to health benefits and training staff. The success of any intervention also relies on the setting and method that will be employed in its implementation.

Policy-makers must be cognizant of the fact that no singular government intervention/policy, operating on its own, can have the effect of directly reducing dementia onset/prevalence and changing lifestyle habits. Six actions for policy-makers are identified in this issues brief which have the potential to have immeasurable benefits: i) development of a comprehensive dementia prevention strategy, ii) establishment of a body whose aim is to keep track of scientific research (central to this will be the establishment of a national digital dementia research repository), iii) ensuring a multisectoral approach is adopted in the fight against dementia that includes both 'traditional' and 'incidental' health agencies, iv) continued investment into research and innovation, v) identifying incentives beyond the health domain and vi) development of longevity literacy programs. These actions all have as their foundation the Health in all Policies Initiative and social determinants of health approach.

1 Introduction

1.1 What is the problem?

Dementia is a collective term for a number of disorders that cause decline in a person's memory, judgement or language that affects everyday functioning (1). As dementia progresses, forgetfulness and confusion grow and in the most advanced stage, dementia patients become unable to care for themselves. Dementia therefore can range from mild to severe. Persons with mild cognitive impairment for example, may develop difficulty multi-tasking and short-term memory losses but are able to perform usual daily tasks with little difficulty and may remain stable without further decline in cognitive abilities for years. More severe cases however may develop short and long term memory loss, personality and behavioural changes, delusions and difficulty coordinating movement leading to an inability to function independently.

In Australia, deaths as a result of dementia have now taken over cerebrovascular diseases as the second leading causes of death (2). Without new ways to delay dementia risk and incidence, dementia will quickly outrank heart disease as the leading cause of death in Australia and government spending on the condition will potentially reach $4.5 billion by 2030 (3). At present, over a quarter million Australians suffer from dementia and projected estimates indicate that the figure can reach a high of nearly one million by 2050 (4).

There has been considerable investment in scientific research in the fight against dementia by both governments and non-governmental organisations alike and undoubtedly much more is needed. Scientific studies however take time and it is in our best interest to develop interim intervention strategies using the best evidence presently available for reducing dementia risk, delaying onset of disease and reducing prevalence until more conclusive findings are available.

In a study commissioned by Alzheimer's Australia, it was reported that any intervention that could delay the onset of dementia by 2 years has the potential to reduce the number of people developing dementia by 13% while delaying onset by 5 years could reduce that number by up to 35% (5). We know that dementia may be delayed or prevented by targeting modifiable lifestyle factors (6, 7). Diet and physical activity are two such factors that have been shown to promote brain health and offer some protection against cognitive decline. Moreover, diet and physical activity have also been recognised as risk factors for developing other conditions such as cardiovascular disease, diabetes, hypertensive diseases and certain cancers all of which are leading causes of death in Australia (8). Investment in diet and physical activity interventions should be strongly considered in preventing and slowing the progress of dementia as these have the potential to reap other health and wellbeing benefits as well.

1.2 Why is this relevant to policymakers?

The recently released 2015 Intergenerational Report highlights the demographic changes that Australia is expected to undergo over the next 40 years (9). These demographic changes have serious health and social expenditure implications. Age is presently the strongest known predictor of dementia and these projected figures seem to highlight that a dementia epidemic

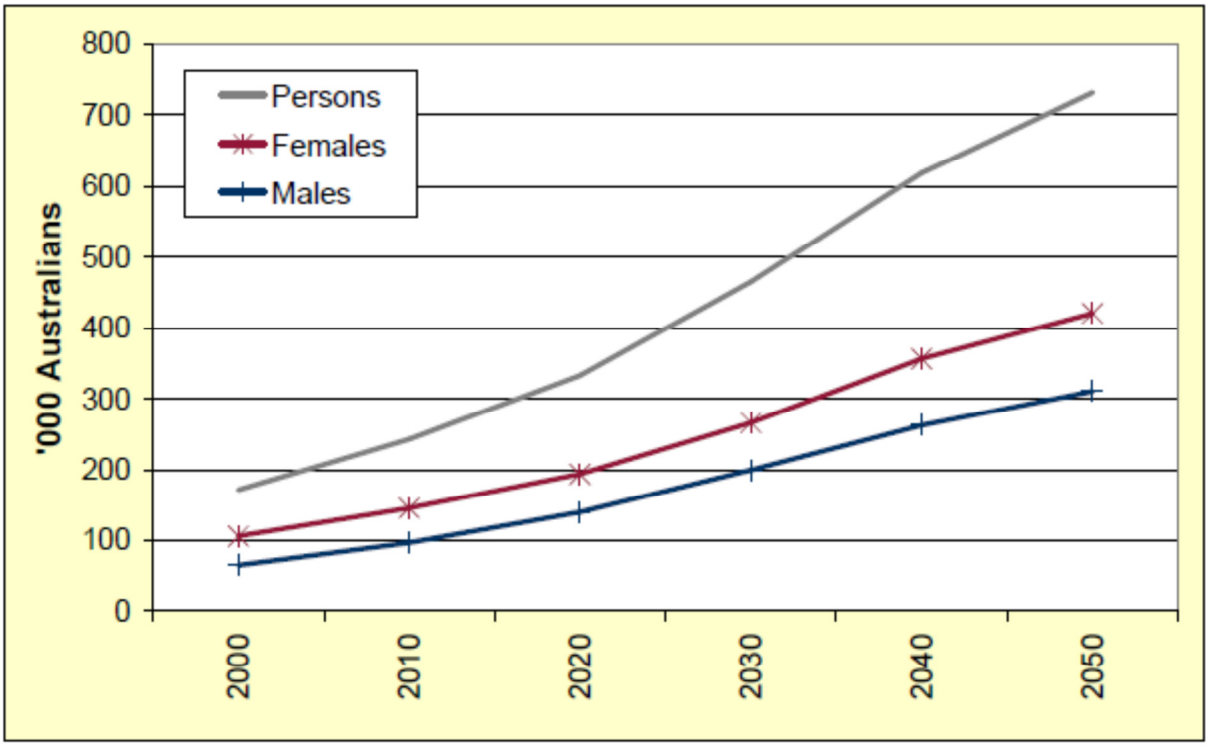
may lie ahead. Australians will continue to record long life expectancies and by 2054 males are expected to live an estimated 95.1 years and females 96.6 years (9). The structure of Australia's population will also continue to change with a greater proportion of the population aged 65 and over (9). Further, the number of Australians in this age group is projected to more than double by 2054-55 compared to 2015 population estimates. Increases in both the number and proportion of Australians aged 85 and over are also expected accounting for a projected 4.9 per cent of the population, or nearly 2 million Australians (9). Research suggests that dementia prevalence is highest in the 85-89 age group due to the relatively large number of people within the age bracket and that this will continue to be the trend (10). Figures 1 and 2 below show dementia prevalence projections for Australia:

Figure 1: Total Australian dementia prevalence projections, by age (2005 – 2050)

Age Group	**2005** ('000)	**2010** ('000)	**2020** ('000)	**2030** ('000)	**2040** ('000)	**2050** ('000)
0-59	1.67	1.70	1.74	1.76	1.77	1.76
60-64	8.32	10.76	12.48	13.08	13.14	14.32
65-69	11.28	13.45	18.70	21.76	22.67	23.27
70-74	21.18	24.52	38.54	45.45	47.91	48.33
75-79	33.30	33.43	47.48	67.58	79.47	83.62
80-84	49.07	54.31	66.13	107.35	129.13	138.39
85-89	41.52	55.35	65.30	97.73	142.80	171.96
90-94	28.10	33.73	54.21	70.98	120.28	150.66
95+	10.41	15.25	28.36	39.76	61.92	98.71
% of Population	**1.01**	**1.14**	**1.44**	**1.88**	**2.40**	**2.77**

Source: Access Economics. 2005. Dementia Estimates and Projections: Australian States and Territories. (11)

Figure 2: Projected increases in dementia cases, elderly population and total population for Australia, 2000 - 2050



Source: Access Economics. 2007. Dementia Estimates and Projections: Queensland and its Regions. (12)

The challenges presented by increased dementia prevalence have continued to capture the attention of both governments and other stakeholders[1]. Earlier this year, the Australian Government announced a $46 million commitment to provide joint fellowships supporting early-career researchers in the field of dementia research. The National Health and Medical Research Council (NHMRC) and the Australian Research Council (ARC) have worked jointly on ensuring the newly-supported research takes into account the social, economic, cultural and complex consequences of dementia (13). Prior to this, in 2014, the Australian Government announced its' plan to boost innovation and research in relation to dementia by providing an additional $200 million over five years. In 2012, Australian health ministers recognised dementia as the ninth National Health Priority Area, and the Australian Government announced its intention to reform aged care[2]. Other government initiatives since then have included the formation of the Dementia Collaborative Research Centres (DCRC) and development of other

[1] Stakeholders involved in the development and implementation of health intervention and policy are varied. Some examples of these stakeholders are departments of trade, transport, health, finance, human rights along with non-state actors and humanitarian agencies.

[2] The reformation of aged care is a relevant issue for the care of dementia sufferers in aged-care facilities and hospitals but is beyond the scope of this issues brief.

strategic grants aimed to support dementia-related research that could inform policy. Most recently, the Australian government announced its investment of $54.5 million over a four year period in response to the Dementia Forum Options Report produced in late 2014. These funds will be used to establish Severe Behaviour Response Teams – a mobile workforce of clinicians providing expert advice to residential aged care providers.

Despite the fact that innumerable reports and studies have been published on government expenditure on dementia and the need for provision of services for people with dementia and their carers and the urgent need for interventions to reduce risk and delay onset (3, 14, 15), these have not resulted in a comprehensive dementia prevention strategy. As such, while the government actions presented above are promising, more must be done to address the root causes of the disease and to develop supportive environments that help individuals take ownership of their health. For example, longevity literacy is one initiative that ought to be undertaken by the Australian government in order to promote greater accountability for health at an individual level. With increased life expectancy, there is a need for individuals to understand that they may be living far longer than they expect and that as a result of pressures on state resources may be increasingly called upon to be more responsible and accountable for their own health and wellbeing.

1.3 Aims

The aims of this issues brief are as follows:

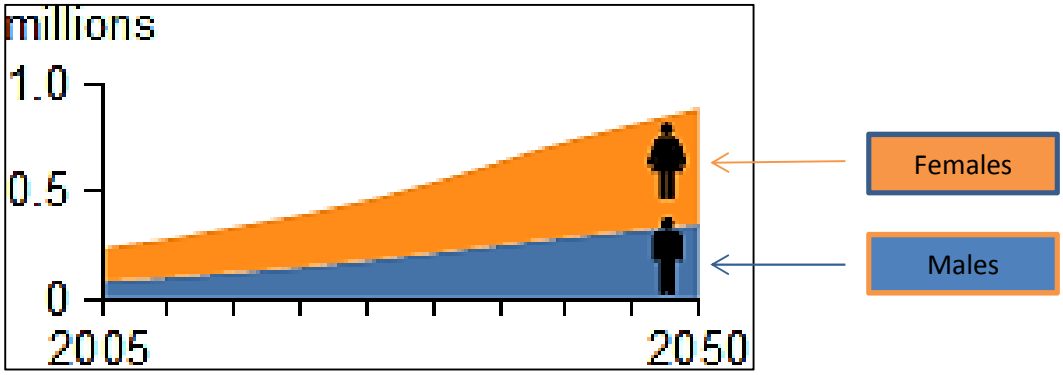
1. To examine published studies and reports in order to make inferences about the effectiveness of diet and physical activity interventions aimed to reduce dementia onset and prevalence.
2. To present a case for greater investment in diet and physical activity interventions to reduce dementia onset and prevalence.
3. To provide some suggestions to policymakers on the way forward.

2 What does the research tell us?

2.1 Number of people affected and future projections

In 2013, an estimated 322,000 Australians had dementia and it was predicted that this figure would reach almost 400,000 by 2020 and just fewer than 1 million by 2050 – See Figure 3 below (16). In addition, one in 10 Australians aged 65 and over had dementia in 2011 compared to 3 in 10 Australians aged 85 and over (16). Each week, there are 1,700 new cases of dementia in Australia; approximately one person every 6 minutes (17). This is expected to grow to 7,400 new cases each week by 2050 (17).

Figure 3: Estimated Dementia Projection to 2050



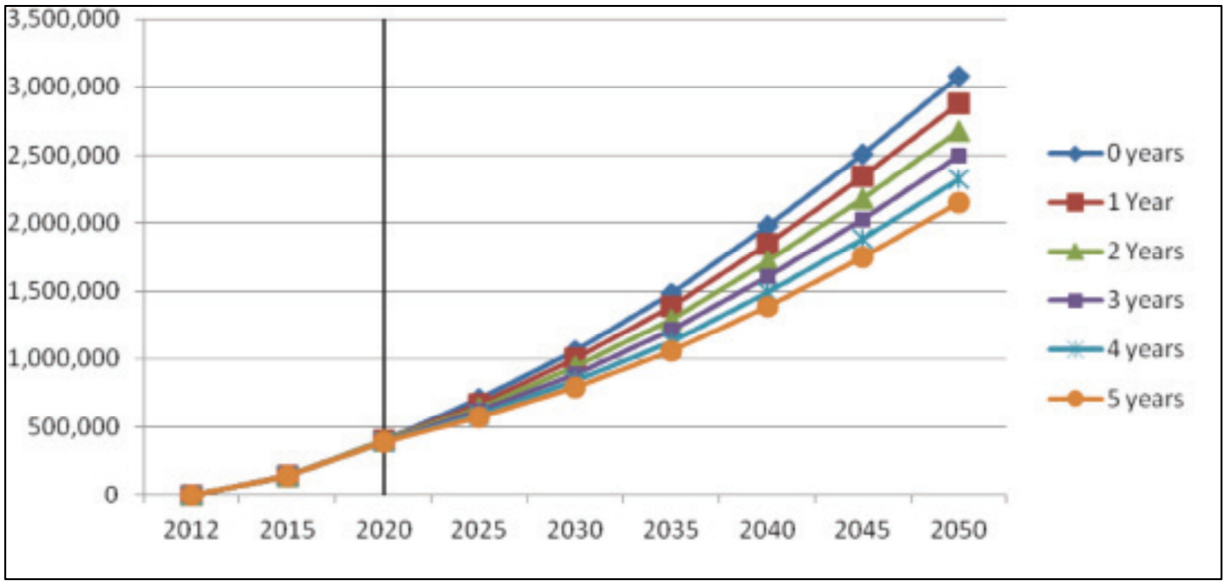
Source: Australian Institute of Health and Welfare. 2015. About Dementia. Available from www.aihw.gov.au/dementia/. (18)

2.2 The effect of delaying onset of dementia

Reducing the prevalence or delaying the onset of dementia is crucial to the fight to reduce the impact of the disease, both financially and on individuals (19). Delaying dementia onset lessens the average number of years spent living with the disease (20). Those living with dementia for longer periods tend to require considerably more health services per annum than newly diagnosed individuals and this has substantial public health resource allocation implications (20). Even delaying the onset by 5 years is predicted, in time, to halve the number of people with dementia and have significant economic and societal effects (21).

In a report for Alzheimer's Australia, the potential impact of possible interventions to delay the onset of dementia on future prevalence of the condition was demonstrated (5). Specifically, the report estimated that any intervention that could delay the onset of dementia by 2 years, introduced in 2020, would reduce the cumulative number of people developing dementia between 2012 and 2050 by 13%, or 398,000 people (5). Further, any intervention that would delay the onset of dementia by 5 years would reduce the cumulative number of people developing dementia for the same period to 925,000 people i.e. a 30% reduction (5). Figure 4 below shows the possible effect of intervention strategies:

Figure 4: Changes in new cases of dementia due to the implementation of an intervention starting in 2020 resulting in various lengths of onset delay



Source: Vickland et al. 2012. Modelling the Impact of Interventions to Delay the Onset of Dementia in Australia – A Report for Alzheimer's Australia. (5)

These projections are comparable to other Australian studies that have modelled the impact of delaying onset on future prevalence numbers. For example, in a report produced by Access Economics it was estimated that a 5-year delay in Alzheimer's disease[3] (the most common form of dementia) onset from 2005 would decrease prevalence by 48.5% in 2040 (20) while Jorm and colleagues estimated that delaying onset of dementia by 5 years from 2000 would decrease prevalence by 44% in 2050 (22); and Vickland et al (2012) estimated that delaying onset of dementia by 5 years between 2010 and 2040 would decrease prevalence by 37% in 2040 (5).

2.3 Evidence in support of modifiable lifestyle changes

According to Alzheimer's Australia:

> "…current research indicates that the onset of dementia may be delayed or prevented by changes to health and lifestyle choices. Some of these preventive factors include having a healthy diet, promoting physical and cognitive activity , and controlling cardiovascular risk factors, including diabetes, high cholesterol, and hypertension (19)".

These health and lifestyle choices referred to are also known as modifiable risk factors and can be can be divided into three categories: brain risk factors, body risk factors and heart risk factors (23):

[3] Alzheimer's disease – The most common form of dementia.

2.3.1 Brain risk factors (mental and social activity)

Several large longitudinal studies have found that increased levels of leisure and mental activity in late life is associated with an approximate 50% lower incidence of dementia (24).

i. Mental Activities - The beneficial effect of stimulating mental activities has been centred on the theory of brain reserve i.e. the possibility that the activity provides a reserve that delays the onset of the clinical manifestations of dementia. Increased engagement in mentally challenging activities has been shown to improve cognitive function, reduce cognitive decline and reduce risk of dementia (25, 26). Such activities include those that exercise the brain and build cognitive reserve - they should be complex, involve learning new things and be done frequently (26). Reading, doing puzzles, sudoku, playing musical instruments, doing art and participating in leisure activities such as sports, hobbies, dancing and gardening have all been shown to confer benefit by building cognitive reserve (26).

ii. Leisure Activities - Some studies have also examined the association of leisure-activities i.e. activities that are not categorised as planned exercise for a health purpose, and incident dementia/Alzheimer's disease. Evidence shows that individuals participating at least twice a week in a leisure time physical activity have 50% lower odds of dementia compared with sedentary persons (27) and that engagement in leisure activities may reduce the risk of incident dementia, possibly by providing a reserve that delays the onset of clinical manifestations of the disease (25). An area requiring further study that has been suggested is the clarification of whether increased participation in leisure activities lowers the risk of developing dementia directly or if this observed relationship is the result of declined participation in leisure activities during the preclinical phase of disease (28).

2.3.2 Body risk factors (diet, physical activity, alcohol intake)

Evidence suggests that a healthy diet, regular engagement in physical activity and moderate consumption of alcohol are associated with better cognitive outcome[4].

2.3.2.1 Diet

Both single nutrients and dietary patterns have been studied in relation to cognitive health but due to the complex interplay of nutrients, such studies have yielded mixed findings. Evidence pertaining to some key food and nutrient components is presented below:

i. Dietary Lipids – Studies suggest that higher ratios of saturated fat to mono and polyunsaturated fats are predictive of negative cognitive outcomes. It is this

[4] Cognitive outcome is of or relating to mental/brain function.

evidence that has led to increased focus on the Mediterranean diet which is traditionally rich in olive oil (a good source of monounsaturated fat).

ii. Cholesterol - There is evidence that elevated mid-life serum cholesterol levels are associated with increased risk of Alzheimer's disease in old age (29).

iii. B vitamins – Deficiencies of some micronutrients (especially B1, B2, B6 and B12) commonly described in older ages have been found to be significantly associated with cognitive impairment (30). A meta-analysis[5] conducted in 2013 using 5 eligible cohort studies examining effects of B vitamins or folate on prevention of Alzheimer's disease showed that low baseline serum folate levels was associated with increased risk of Alzheimer's disease (31).

iv. Antioxidants – Research suggests that oxidative stress and inflammation can lead to Alzheimer's disease because of an increase in free radicals and the damage they cause to neuronal cells. Antioxidant nutrients (vitamin C, vitamin E, carotenoids, flavonoids), found in many fruits and berries are thought to be the key mediators in this mechanism since they can hinder the effects of dangerous free radicals (32).

v. Fish – The fatty acids found in fish are thought to be linked to cognitive function through atherosclerosis, thrombosis or inflammation via an effect on brain development and membrane functioning or via accumulation of β-amyloid (33). Regular consumption of fish (a good source of DHA and Omega-3 polyunsaturated fatty acids) has been shown to lower the risk of dementia by up to 37% (34).

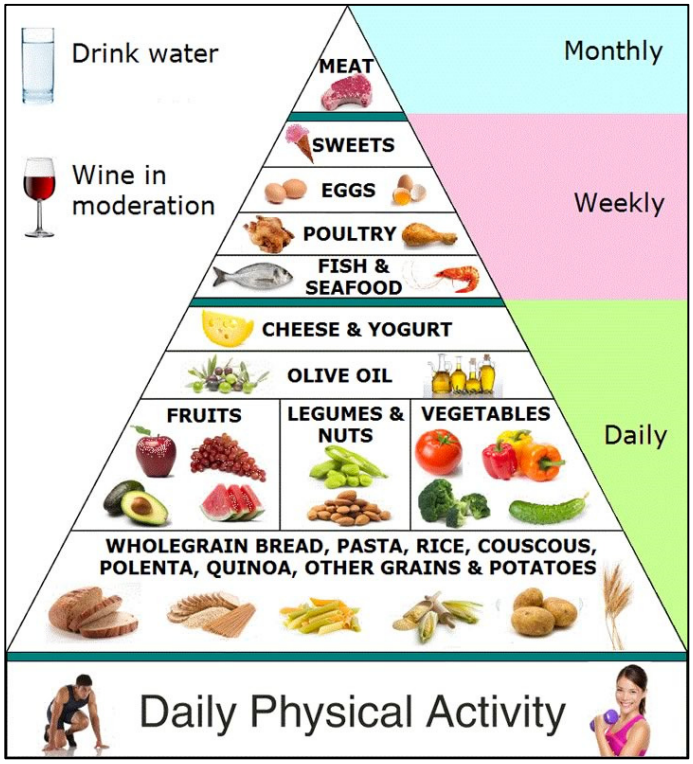
vi. Vegetables and Legumes – Diets rich in vegetables and legumes have been associated with better cognitive outcome in the literature with studies showing that always eating vegetables and always consuming legumes is inversely associated with cognitive decline and risk of developing Alzheimer's disease (33, 35).

vii. Caloric Intake – In a recent Australian prospective study[6] it was reported that energy intake was associated with greater risk of cognitive impairment with the effect being even more potent for a measure of excessive caloric intake (36). However, because the long-term effect of caloric restriction in older age groups is unknown, this management route is not usually recommended (37).

viii. Mediterranean Diet (MeDi) - The Mediterranean diet has been widely reported to be associated with a number of favourable health outcomes including reduced risk of cognitive impairment, cancers and cardiovascular disease and increased life expectancy (30, 38-41). Figure 5 below highlights the basic components of the Mediterranean diet.

[5] Meta-analysis is a statistical technique for combining the findings from independent studies.
[6] A prospective study watches for outcomes, such as the development of a disease, during the study period and relates this to other factors such as suspected risk or protection factor(s).

Figure 5: Basic Components of the Mediterranean Diet



Source: http://www.diet-blog.com/13/mediterranean-diet-wins-again.php. (42)

2.3.2.2 Physical Activity

Physical activity has been shown to promote functional neuro-protective changes in the hippocampus of the brain- a region central to learning and memory (43). This brain region has been found to be one of the first areas affected by dementia. A brief summary of the results of studies related to physical activity and dementia/mental function is shown below:

i. Physical Activity and Incident Dementia/Alzheimer's disease - Most studies have demonstrated that high levels of physical activity in older adults with no dementia is associated with a 30 to 50% reduction in the risk of cognitive decline and dementia (44). Some studies have theorised that poor physical function may precede the onset of dementia and Alzheimer's disease and higher levels of physical function may be associated with a delayed onset (45). The results as it relates to physical activity and incident dementia/Alzheimer's disease are convincing as they have been conducted in a variety of ethnic settings with reports being similar.

ii. Physical Activity and Improving Functional Status - Function and cognition influence each other (45). Mobility is one aspect of physical function that is typically compromised as Alzheimer's disease symptoms progress due to white matter changes of the brain associated with hippocampal atrophy (45). Links

between physical activity and improved walking speeds in Alzheimer's disease sufferers have been highlighted in the literature and have been linked to the fact that dementia targets those walking parameters that seem to be predictive indicators of falls (shortened stride length, slowing down and increased double limb support time) (46). A meta-analysis conducted in 2008 that included 21 exercise trials with cognitively impaired individuals and 20 exercise trials with cognitively intact individuals revealed that those with impaired cognitive function who participated in exercise rehabilitation programs had similar strength and endurance training outcomes as age and gender matched cognitively intact older participants (47). This suggests that individuals with dementia and other forms of cognitive impairment should take part in exercise rehabilitation programs (47).

iii. Physical Activity in Cognitive Impairment Therapy - A Cochrane Review[7] conducted in 2008 highlighted that there is insufficient evidence to be able to say whether or not physical activity programs are beneficial for people with dementia especially since there has been no inclusion of secondary outcomes relating to family caregiver outcomes and use of health services provided in any study (44).

iv. Physical Activity in those with Normal Cognitive Function - A recent Cochrane Review conducted analysing 11 randomised controlled trials with participants older than 55 years of age was able to conclude that there is evidence that aerobic physical activities are beneficial for cognitive function in older adults. Further studies are required to determine whether the cognitive benefits noted were a result of improvements in cardiovascular fitness (48).

2.3.2.3 Alcohol Intake

In a meta-analysis of 15 prospective studies results suggested that light to moderate alcohol consumption in older adults is associated with reduced risk of dementia (49). This seeming "J" or "U" shaped relationship has been highlighted in other case-control studies (50). Associations between "former drinkers" and risk of cognitive impairment remains unclear in the literature though since it is possible that they may have stopped drinking for reasons such as health issues that also predispose to cognitive impairment (51).

2.3.3 Heart Risk Factors (blood pressure, body mass index, cholesterol, diabetes, smoking)

i. Blood pressure – Vascular risk factors have long been known to be involved in the development of both Alzheimer's disease and vascular dementia.

[7] Cochrane Reviews are regarded as the highest standard in evidence-based health care. In a Cochrane Review, all high quality research evidence relevant to a specific research question are identified, synthesised and interpreted in order to draw conclusions.

Hypertension in midlife is thought to be a significant risk factor for the later development of both Alzheimer's disease and vascular dementia. Hypotension in later life appears to be associated with the development of Alzheimer's disease in particular (52).

ii. Body Mass Index – In a meta-analysis of 16 studies it was reported that in midlife, underweight body mass index, overweight body mass index and obese body mass index were all associated with increased risk of dementia compared with normal body mass index (53). They suggest a U-shaped relationship between midlife body mass index and dementia risk.

iii. Cholesterol – There is evidence that elevated mid-life serum cholesterol levels are associated with increased risk of Alzheimer's disease in old age (29). Studies have focused on the most important genetic risk factor for Alzheimer's disease, APOE-e4 allele, the protein product of which is the principal cholesterol transport in the brain (29).

iv. Diabetes – Research shows a clear link between dementia and type 2 diabetes. Dementia occurs more frequently in people with type 2 diabetes than in the general population - a review of relevant studies found that diabetes was associated with a 47% increased risk of any dementia, a 39% increased risk of Alzheimer's disease, and a 138% increased risk of vascular dementia (54). Impaired insulin secretion, insulin resistance and glucose intolerance are also associated with an increased risk of dementia (54). While there may be many contributing factors to this increased risk, vascular disease has consistently been implicated as having a possible causal effect.

v. Smoking – In a meta-analysis of 19 prospective studies with at least 12 months follow-up, when compared with people who had never smoked, current smokers had an increased risk of dementia and cognitive decline ranging from 40% to 80% depending on the outcome examined (55).

Preservation of cognitive abilities is central to the maintenance of independence and quality of life among older adults (56). The evidence presented above highlights that the brain needs to be stimulated and provided with nutrients to build and maintain its structure and to be protected from cognitive decline. Diets low in saturated fat, high in legumes, fruits and vegetables, moderate in ethanol intake and low in meat and dairy have been highlighted as having a protective effect against the development of dementia. While traditionally, the single nutrient approach has been used to examine the relationship between diet and disease, many researchers now support the examination of dietary patterns such as the Mediterranean diet as the dynamic interplay of food items makes the implication of a single nutrient almost impossible (41). Studies suggest that adults who engage in physical activity have a reduced risk of cognitive decline and dementia and have a higher functional status due to improved strength, endurance and balance. Overall though, further research is

needed to examine whether other dietary patterns exist that can prevent/delay dementia onset and also to conclusively state whether physical activity is beneficial to persons who already have dementia.

3 Why highlight diet and physical activity interventions?

From the evidence presented above, diet and physical activity have been shown to have an effect on cognitive status. In addition, unhealthy diets and physical inactivity have been shown to be key risk factors for diseases such as Type 2 diabetes and metabolic syndrome, some cancers (colon, breast, endometrial and lung cancer) and cardiovascular diseases (57, 58) which are known to be leading causes of death in Australia (8). A balanced diet and regular physical activity have also been found to strengthen bones and muscles, improve mental health and mood and improve ability to do daily activities and prevent falls (58).

Results from the Australian Bureau of Statistics National Health Survey (2011-2013) show that most Australian adults do not meet the National Physical Activity Guidelines (to do at least 30 minutes of moderate intensity physical activity on most days) as more than half the Australian population is inactive (59). Levels of physical activity were also shown to decline with age. Survey data showed that persons 75 years and over recorded the highest levels of inactivity (approximately 20 minutes per day) when compared with other age groups (60). Sedentary activities occupied an average of 39 hours per week for adults with much of this time spent watching television and using the computer for non-work purposes (60).

Findings from the diet section of the survey showed that nearly two-thirds (63%) of the Australian population are now classified as overweight or obese (61). A closer investigation of dietary habits revealed that over 33% of total energy consumed was from foods considered to be of little nutritional value i.e. high in saturated fats, sugars, salt and/or alcohol (62). Alcoholic beverages (4.8% of energy), cakes, muffins scones and cake-type desserts (3.4%), confectionery and cereal/nut/fruit/seed bars (2.8%), pastries (2.6%), sweet biscuits and savoury biscuits (2.5%) and soft drinks and flavoured mineral waters (1.9%) were found to be the main culprits (62). In addition, over 2.3 million Australians aged 15 years and over reported that they were on a diet to lose weight or for some other health reason in 2011-12 (62). Dieting was most prevalent in the 51-70 age group where 19% of females and 15% of males were on some kind of diet (62).

World Health Assembly Resolution WHA55.23 (page 2) provides an important substratum for action as it urges Member States to, ”… promote health and reduce the common risks of chronic non-communicable diseases that stem from poor diet and physical inactivity by essential public health action and integration of preventive measures in the functions of health services” (63).

Promoting healthy ageing and the maintenance of physical and mental function in older age are undoubtedly major challenges (64). Dementia prevalence has the potential to reach epidemic proportions if there is no risk reduction at the population-level (65, 66). As dementia has no cure there is a need for effective treatment approaches. In light of the evidence that highlights the possible beneficial effects of diet and physical activity on brain function, interventions that focus on these should be encouraged as even a modest protective result can result in significant public health impact.

4 What works?

A successful diet and physical activity intervention is one that encourages and results in significant and sustainable behaviour changes (67). In a study aimed to provide a broad list of good practice characteristics in interventions and policies targeting healthy diet and physical activity, it was suggested that researchers, practitioners and policy makers should account for 53 key characteristics. These are categorised into three main domains and should be carefully considered when planning, developing and reporting interventions promoting healthy eating and physical activity (67). A brief snapshot of some of the items included in each domain is presented below. For the full list of good practice characteristics in interventions see Appendix 1.

i. Main intervention characteristics – A list of 18 items that ought to be considered are presented. These include the identification of a well-defined target audience/group, well defined target behaviours and identification of the forms of delivery that will be employed.
ii. Monitoring and evaluation – Items that ought to be considered within this domain include costs in relation to target outcomes, evaluation of risks, sustainability of the intervention and determination of whether the effects are generaliseable.
iii. Implementation – Included here are attrition rate considerations, specification of resources and stakeholder support (feasibility and acceptability).

In addition to taking into consideration the characteristics mentioned above, it is also critical to consider which interventions will be most successful within a given target group. The World Health Organisation publication 'Interventions on Diet and Physical Activity – What Works' (2009), is a useful resource for researchers and policymakers to determine the effects of various types of diet and physical activity interventions across various age-groups and settings (68). As it relates to older adults, research shows that group physical activity programmes have reported improvements in psychosocial outcomes with evidence indicating that such programmes must be easily accessible. Greater accessibility can be accomplished by conducting the intervention at venues where they regularly meet or by making it comfortable and convenient for example delivery of fruit and vegetables via a meals on wheels programme (68). Appendix 2 presents the evidence tables from the World Health Organisation publication highlighting the effectiveness of a variety of interventions in older adults.

When deciding on an implementation strategy, a variety of settings and methods can be considered. For example an intervention can be implemented at schools, workplaces, religious settings or in the community. Depending on the setting, the medium and methods used may differ, for example mass media may be suitable in one context while individualised materials may be more applicable in another. It is critical to know the effectiveness of all settings and modes of message delivery. Often though, strategies and methods employed in one setting are cross-cutting and tend to be broadly applicable in other settings as well:

i. Physical Environment Interventions- Interventions/policies that have the ability to make physical modifications and that can reach large populations in the environments where they make their choices are the most successful (68). Included in this category are point-of-purchase prompts and messages in stores that encourage shoppers to select options conducive to good health and increasing and maintaining safe public spaces for physical activity. Appendix 3 presents an excerpt of 'The Supportive Environments for Physical Activity and Health Project (2009)' developed in Queensland which highlights physical environment modification approaches that can be carried out by local government (69). Such approaches can be developed and enacted in other states at the local government level.

ii. Workplace Interventions– Research points to the use of carefully organised, accessible and sustainable activities to derive maximum health benefits in the workplace. Including workers in the planning and implementation phase of workplace interventions has been shown to be beneficial (55). An evidence-based module produced in Australia reported that effective types of physical activity strategies to include in Australian workplace settings include signage encouraging stair use, providing access to physical activity spaces and providing education and peer support (70). This is supported by the available scientific literature where studies have highlighted the effectiveness of signage that encourages use of stairs instead of an elevator or escalator results in a median increase in stair climbing of 53.9% and that experimentally reducing the availability of escalators and modelling more active behaviours increases stair use (71). In terms of nutrition interventions applicable at workplace canteens and shops, point-of-purchase promotions, access and availability of healthy food options and food labelling were pinpointed as being most effective (70). Other examples of interventions that have been shown to be effective in a workplace setting include lunch hour walking programs, instructor-led group exercise and healthy taste clubs (71).

iii. Community-based Interventions – Evidence within this multidimensional domain points to the effectiveness of diet education and physical activity programmes

that target high-risk groups. Community-based interventions that incorporate a variety of activities , include both diet and physical activity components and have a robust educational component with strong theoretical underpinnings seem to be associated with the greatest levels of sustainability (68). Policies for providing wide and safe routes for walking and biking in communities, maintaining public parks, reducing exposure to unhealthy fast food or to high-calorie/low-nutrient foods, menu labelling and increasing access and availability to healthy foods appear crucial to sustainable behaviour change (71).

iv. Religious Setting Interventions – There is consistent evidence that intervention strategies that are planned with the help of spiritual leaders and members of their congregation have high levels of success. Such interventions tend to include counselling, group education and self-help strategies (68).

v. Mass-media based Interventions – Multi-component mass media campaigns that involve a community participation approach have the highest rates of success (68). Some evidence however has shown that an individualised material approach tends to be more effective in helping to encourage physical activity and diet change. In a study comparing the effects of motivationally matched print materials versus motivationally matched telephone counselling, both groups had significantly increased physical activity at 6 months, but participants receiving the print materials were more likely to maintain physical activity change at 12 months (71).

vi. Group-based Interventions – Group focused interventions allow for social interaction, peer-support and positive observational learning. Typically administered using a small number of participants, the group initially meets quite often with frequency decreasing over time - this has proven problematic particularly as it relates to interventions to improve eating habits where self-monitoring is encouraged. One technique that can be used to combat this is to include friends and wider support networks to ensure that target goals are achieved and maintained.

vii. Individual-focused Interventions – Personalised interventions that allow for the development of tailor-made strategies to suit an individual's health goals have been shown to have some short-term success (up to 1 year) (71). A combined approach incorporating self-monitoring and counselling have also been shown to improve the effectiveness of the intervention (71).

viii. Computer/Technology-based Interventions – Overall, studies aimed to evaluate the effectiveness of technology-based interventions have produced mixed results. What has been established though is that programs incorporating both an online information provision element along with counselling (provided online) have more success than the use of Intervention programs alone. Supermarket kiosk programs that provide onsite nutrition information have also been shown

to be effective in improving fruit, fibre and saturated-fat intake (71). There are several advantages to using a computer-based intervention as it allows for many people to be reached in the comfort of their own homes and allows for tailored intervention programs to be developed. In addition, they are cost effective and provide an opportunity for interaction for socially isolated individuals (71).

ix. Multicomponent Interventions – Such interventions have reported some success although the optimal combination of behaviour change strategies to be included in a given intervention program requires further study (57). Multicomponent intervention programs include: some combination of technology/media; group or individual-based delivery strategies; computerised assessment and feedback plus videotapes, telephone follow-up, or individual counselling; physician advice plus motivational videotapes, telephone calls, and interactive mail; group sessions plus individual motivational interviewing; or individual plus group sessions (71).

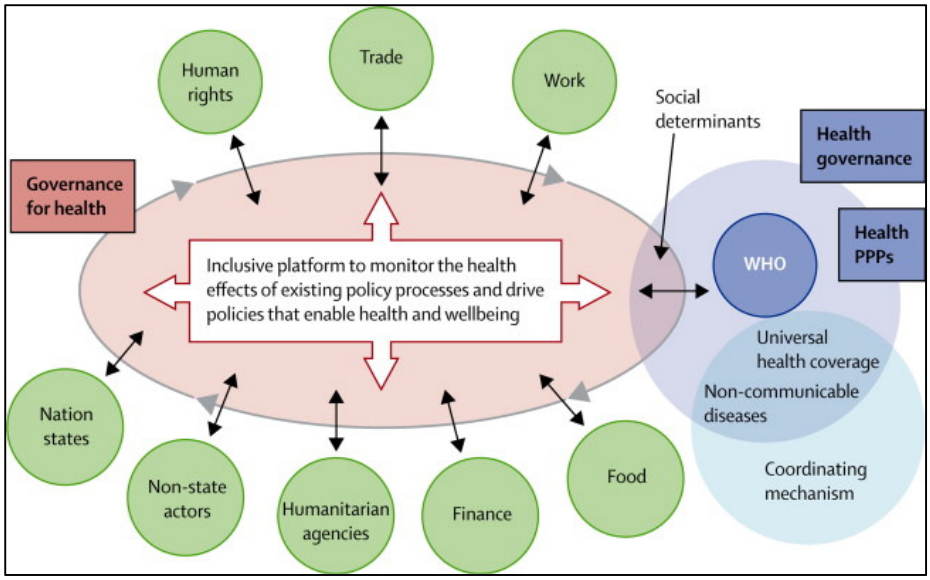
x. Interventions with special considerations for vulnerable groups (minority groups and socio-economically disadvantaged populations) – Differences in education, culture, language, ethnicity and lifestyle have been proven to affect the effectiveness of any intervention. Multicomponent and group-based interventions have demonstrated positive diet and physical activity changes among vulnerable groups while computer/technology-based interventions reported limited success particularly among low-literacy individuals who may be unwilling to click on links and unable to understand information presented on websites (71). The use of lay health advisors and community health workers who speak the same language, have similar beliefs and live in the same area can increase the success of an intervention among vulnerable groups as they are able to target messages to meet their unique needs and may be viewed as being more identifiable and trustworthy (71).

Several other interventions have been highlighted in the literature as being effective. These interventions have revolved around the ideas of policy and incentive provision schemes. For example, the lowering of insurance premiums for those who participate in programs aimed to improve diet and physical activity behaviours (71). In addition, enacting and enforcing policies that support information provision (e.g. mandatory calorie labelling) and limiting the use of certain food components in the food supply (e.g. trans fats) has been shown to positively influence food choices and foods available (71). These types of approaches can engender supportive environments where making healthy food choices and engaging in regular physical activity are second nature (71).

For an intervention aimed to decrease dementia onset/prevalence to be considered a success, it must encourage and result in significant and sustainable behaviour change. Sustainability is paramount since it takes into consideration individual, social and

environmental elements. While health issues are frequently considered to be problems for health departments to solve, the development of diseases such as dementia are impacted by a wide variety of determinants - genetics, education, access to safe and well maintained physical activity spaces, access to affordable healthy foods and existence of a supportive environment. For all these determinants to be addressed there must be support and acceptance from all stakeholders that they have a key role to play. Figure 6 below identifies some of the stakeholders involved in the implementation of any health intervention (72).

Figure 6: Stakeholders involved in the development and implementation of health interventions and policy



Source: Ottersen et al. The political origins of health inequity: prospects for change. The Lancet, Volume 383, Issue 9917, 630-667. (72)

5 What should policymakers do?

Policy-makers must be cognizant of the fact that no singular government intervention/policy, operating on its own, can have the effect of directly reducing dementia onset/prevalence and changing lifestyle habits. To compound this issue, some thinkers postulate that people are in control of what happens to them health-wise while others believe that the environment acts upon people leading to development of various lifestyle habits (73). For any government policy/intervention to work there must be recognition that the environment does in fact influence the way we live our lives and our ability to change unhealthy behaviours into healthy ones.

Six actions that can be taken by policy makers are identified below that have the potential to result in inestimable benefit in the fight against dementia. These actions are not limited to dementia risk reduction interventions but rather to any public health intervention. Such

actions though must be bolstered by strong education and communication strategies in order to be effective[8]:

i. Development of a comprehensive dementia prevention strategy – The National Framework for Action on Dementia (2006 – 2010) was implemented in the 2005 Australian Federal Budget (74). This initiative however was terminated in 2011 after an evaluation found that it did not address key critical issues (74). These issues included primary care, a communications strategy and risk reduction (74). Australia needs to develop an overarching plan that takes into consideration these key issues if reducing dementia onset and prevalence is a priority. Being the first country to establish dementia as a national health priority with a funded five year plan (74), the Australian government needs to act quickly to develop a coordinated dementia prevention strategy.

ii. Keeping track of scientific research - A research of the grey and scientific literature in the Australian context reveals that there have been quite a number of dementia initiatives within the past few years – scientific studies, reports by various stakeholders, conferences and public awareness campaigns. The establishment of a body whose aim is to keep track of scientific research both within Australia and internationally, to establish clear research and public health priorities as it relates to dementia and to outline the way forward based on the best scientific evidence clearly indicating the roles and levels of accountability of all stakeholders (at both state and federal level) is crucial. Central to this initiative will be the establishment of a national digital dementia research repository that will allow for data sharing among researchers.

iii. Increased engagement of non-health actors/agencies – Key to implementing a successful dementia prevention program is for stakeholders to accept and willingly support the initiative. The establishment of agreed outcomes that are measureable and able to be tracked is the first step and collaborating to develop clear roles for each stakeholder is the second. It is important to note that stakeholders can work through various channels thereby providing access to the broader population as well as well-defined target groups (75). This interplay between stakeholders is critical since unlike other singular disease-causing agents targeted by governments such as tobacco, there are innumerable food products on the market. To compound this issue, while individual food items are capable of contributing to disease development if consumed in excess, they can also result in absolutely no harm if other healthy lifestyle choices are adopted (73).

[8] The actions highlighted in this section take root in the Health in All Policies initiative and social determinants of health approach. These encourage all sectors to consider health and wellbeing in order to improve population health and to take into consideration the social and economic factors that influence the health of all Australians.

Reports have highlighted that some health interventions are best led by 'incidental' and not 'traditional' health agencies (73). For example, in the UK, the Sustrans National Cycle Network (an NGO encouraging cycling through various non-governmental partnerships) led an initiative to increase cycling and walking journeys which was reported to have an estimated health benefit of US$625 million in 2009 (76). As such, states of health and the development of effective and sustainable interventions to reduce dementia onset and prevalence, as with any other health condition, are not simply dependent on the action of ministries/departments of health. Rather, a successful intervention requires that elements of dementia prevention (including the need for healthy eating and active living) be incorporated into the purview of non-health departments such as trade, finance, education, communication, urban planning, agriculture and transport. The health sector in return can also identify policy "windows" across other sectors that can allow them to appreciate the health impact of their initiatives as well (75).

iv. Continued investment into research and innovation – Several intervention strategies that have been highlighted in the literature require further investigation to determine their true impact. Policy makers are keen to know what interventions will produce a positive return on investment by reducing both healthcare costs and disease prevalence. One area where research is needed for example is the development of food taxes and the benefits that could ensue. In 2014, Cancer Council Australia recommended that research be commissioned to identify the impact of a food tax on various socio-economic groups within Australia and the examination of how a food tax and other policy measures could interact to be effective and equitable (77). Further research is also needed to identify innovative ways to detect early signs of dementia and care for those already affected. Individual-level (as opposed to aggregate-level) longitudinal data will ideally be needed in order for these goals to be achieved.

v. Provision of incentives – Policy makers often incur challenges when trying to get all stakeholders to engage in meaningful dialogue that results in a series of implementation actions that all can agree on. This is particularly the case as it refers to non-traditional health actors who now must expand their respective portfolios to infuse elements of healthy eating and active living. The identification of incentives beyond the health domain is therefore critical, especially when economic interests conflict (76).

vi. Provision of greater longevity literacy – At a population level, there must be the development a program to help people understand that they may be living far longer than they expect, and that as a result of pressures on state resources, may be increasingly called upon to be more responsible and accountable for their own health and wellbeing. Since dementia has no known cure and age is

presently the strongest predictor of the disease, this initiative is quite appropriate. Such an action will involve collaboration from both 'traditional' and 'incidental' health agencies e.g. Department of Social Services, Department of Finance, Department of Health, Department of Human Services and various community groups.

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7 Appendix 1: The checklist of good characteristics for healthy diet and physical activity

No.	Best practice characteristic
Main Intervention Characteristics	
1	Target audience well defined
2	Target group needs identified
3	Family involvement*
4	Target behaviour well defined and adjusted to target population
5	Multidimensionality of the approach (individual, social, environmental)
6	Physical environment accounted for
7	Theory applied in the development of the intervention/policy
8	Individual contacts and their intensity specified
9	Duration (number of sessions, their length, and frequency)
10	Forms of delivery
11	Number of components (distinguishable elements/strategies used to prompt healthy diet/physical activity)
12	The use of any theory-based behaviour change techniques
13	Clarity achieved
14	Tailoring content and materials
15	Manuals/exact protocols exist
16	The use of specific behaviour change techniques: self-monitoring and self-management
17	Practitioners well defined
18	Setting characteristics well defined
Monitoring and Evaluation	
19	Costs in relation to obtained general health benefits
20	Costs related to behaviour change
21	Total financial costs of the interventions/policy
22	Outcomes measured with valid, reliable and sensitive tools
23	Effects specified as clinically significant
24	Effects on public-health relevant secondary outcomes
25	Negative consequences (or risks) evaluated
26	Measured outcomes include physiological risk factor indices
27	Efficiency established and reported
28	Sustainable effects
29	Effect sizes
30	Reach
31	Inclusiveness: health, age and gender context
32	Cultural competence and social inclusion of the intervention/policy
33	Generalizability of effects evaluated
34	Participation rates reported
35	Active components identified
36	Ongoing monitoring and measurement of delivery; material monitoring

Implementation	
37	Completion and attrition rates across stages
38	Resources/strategies for staff helping them to invite and follow participants up
39	Strategies promoting long-term participation (maintenance) included
40	Staff training in implementation and facilitation of inter-sectorial collaboration
41	Resources for implementation specified
42	Implementation integrated into existing programs
43	Ongoing support from stakeholders secured
44	Adoption by target staff, settings or institutions
45	Feasible/acceptable for providers, stakeholders and participants
46	Maintenance (the policy/intervention is maintained over time with institutional support)
47	Mutability (the intervention/policy is in the realm of community/target group)
48	Partnership between agencies/organizations to facilitate adoption/implementation
49	Identification of those responsible for implementation; training and feedback for implementers
50	Implementation consistency and adaptations made during delivery assessed
51	Adherence to protocol/protocol fidelity monitored
52	Transferability
53	Contexts of transfer and transfer boundaries

Source: Horodyska et al. Good practice characteristics of diet and physical activity interventions and policies: an umbrella review. BMC Public Health (2015) 15:19. (67)

*Note: * Characteristics identified mainly in documents referring to interventions for children and adolescents*

8 Appendix 2: Excerpt on older adults from WHO publication 'Interventions on diet and physical activity – what works' (2009) (70)

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
Seattle senior farmers' market nutrition pilot programme - Seattle, USA - Low-income seniors interviewed at 6 months (IG[9]=87, CG=44) - Aimed at increasing F&V[10] intake. ***Activities*** - Market baskets were delivered to the homes of seniors every 2 weeks by *Meals on Wheels* drivers. *(Reference: Johnson et al. 1994; Smith et al. 2004)*	**Not reported**	**Effective** A significant increase of 1.04 servings of F&V per participant/day was noted. The percentage of the elderly eating 5 or more F&V servings a day increased from 22% to 39%.	**Not reported**	This system could work well in other areas that have an established *Meals on Wheels* (or similar) infrastructure. Home delivered baskets brought participants joy, stimulated interest in healthy foods and improved quality of life.

[9] IG = Intervention Group
[10] F&V = Fruit and Vegetable

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
CHAMPS II (Community Healthy Activities Model Programme for Seniors) - Members of health maintenance organizations in USA - n=164 persons - 12 months - Aimed to have participants active at least 30 minutes per day on most days of the week. ***Activities*** - Trained staff assisted participants to develop and maintain tailored PA[11] programme - Participants were encouraged to participate in PA that addressed more than 1 component of fitness and function - Participants could choose group (community- based) or individual exercise sessions. *(Reference: Stewart et al. 2001)*	**Insufficient evidence/ promising**	**Effective** Both moderate intensity and total weekly PA increased. Equivalent to five 1- mile walks per week.	**Moderately effective** BMI[12] decreased.	The programme was particularly effective for those who were older, sedentary and overweight, and particularly for women. This study was conducted in a high quality health-care setting but did not include minority groups.

[11] PA = Physical activity
[12] BMI = Body Mass Index

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
CHIPs (Community Health Intervention Programmes) - South Africa; 20 weeks - Under- resourced community - n=98 community dwellings ***Activities*** - Low-intensity seated PA - Peer led; twice a week - Cardiovascular, resistance and flexibility training. *(Ref: Kolbe-Alexander et al. 2006)*	**Not reported**	**Minimally effective** There was an increase in exercise-related energy expenditure, but no increase in total weekly energy expenditure.	**Moderately effective** Balance, strength, lower body muscle strength and systolic blood pressure all increased.	Even if only twice weekly, seated PA resulted in improved measures of functional performance and fitness in seniors. The programme was community-based, and community members were trained as PA leaders. This programme demonstrated sustainability for 8 years.
Strong for life - Massachusetts, USA; 15 weeks - n=102 community dwellings ***Activities*** - 30-minute video programme - 10 exercises (resistance training, 5 min. warm up, 20 min. strength training, 5 min. cool down) - Aim for 3 exercise sessions/week - Occasional calls from trained therapist. *(Reference: Jette et al. 1996)*	**Not reported**	**Minimally effective** 58% participated in PA twice a week. Social functioning scores improved for men and women.	**Moderately effective** Leg muscle strength increased (10%) for those aged < 72 years.	A video-based PA programme may be an effective method to encourage seniors to exercise. However, the exercises might need to be gender specific and target the 'younger' versus 'older' seniors.

Intervention Components *	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
Active for life - 4 community-based organizations implemented either Active Choices (telephone-based intervention over 6 months) or Active Living Every Day (20-week group- based programme). ***Activities*** - Focus on necessary behavioural skills to become more active. *(Reference: Wilcox et al., 2006)*	**Moderately effective** Depressive symptoms and stress decreased and body satisfaction and appearance increased.	**Moderately effective** Significant increase noted in moderate to vigorous activity in both IGs.	**Moderately effective** Both IGs had a decrease in BMI.	These programmes demonstrate successful translation of evidence-based PA programmes in a community of older adults with diverse backgrounds.
Health enhancement programme - Washington, USA; 12 months - n=304 community dwellings ***Activities*** - Health and functional assessment by nurse; personalized health and action plan - Encouraged to enrol in lifetime fitness programme, chronic NCD[13] self- management course, and a meeting with social worker. *(Reference: Phelan et al. 2002)*	**Promising/ insufficient evidence** 85% of participants were able to improve lifestyle to make sustained health changes.	**Moderately effective** The number of inactive participants decreased from 56% to 38%.	**Promising/ insufficient evidence** Health status in IG either improved or remained constant compared to a decrease in CG[14].	This multi-faceted health promotion programme for seniors resulted in increased PA levels. Individual counselling at baseline may positively influence expected outcomes.

[13] NCD = Non-communicable disease
[14] CG = Comparison Group

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
Sheffield community based exercise programme- Sheffield, United Kingdom - n=6420, community dwelling patients from 12 general practitioner practices - 2 years. ***Activities*** - Free supervised PA sessions twice a week – PA sessions of 45 minutes, including cardiovascular, resistance flexibility and coordination training. *(Reference: Munro et al. 2004)*	**Promising/ insufficient evidence** No change was noted in the use of healthcare services between groups.	**Minimally effective** 26% of participants attended 1 or more sessions over the 2-year period (2040 sessions provided).	**Insufficient evidence**	Participants were recruited from private medical practices, a good opportunity to prescribe exercise to inactive older adults. Economic evaluation of the programme showed it was cost-effective and produced small health benefits. More advocacy may be needed to increase engagement and uptake of this community-based exercise opportunity for senior adults.
Greek minimum PA frequency - Greece - n=55 community dwellings - 10 weeks. ***Activities*** - Groups participated in exercise either 1, 2, or 3 times a week - Sessions of 45 minutes. *(Reference: Ourania et al. 2003)*	**Not reported**	**Promising/insufficient evidence** The drop-out rate was low, especially for the once a week group.	**Moderately effective** Dynamic balance, flexibility and endurance and coordination improved.	Improvements occurred even in those exercising only once per week, but greater improvements were noted in those exercising 2 or 3 times per week.

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
Community-based strength/ resistance training for older adults - USA - n=37, community dwelling men and women aged 70 ± 4 years - 6 weeks resistance training. ***Activities*** - Three 45- minute sessions per week - Intensity increased with improved strength during the intervention - Before each session, 20 minutes stretching. *(Reference: Cavani et al., 2002)*	**Not reported**	**Not reported**	**Moderately effective** Improvements noted in upper and lower body strength (arm curls and chair stand tests), and flexibility (upper back scratch and chair sit and-reach), and agility (8 foot up and go). No improvement in 6-minute walk test.	After only 6 weeks of strength training, results showed significant improvement in functional ability in older adults. Improvement in functional fitness plays a role in maintaining independence and delaying frailty.

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
Home-based strength and balance training for older adults - Boston, Massachusetts, USA; - 72 community dwelling men and women aged 77 ± 5.3 years. ***Activities*** - 6 months home-based strength and balance training; 3 times/week - Booklet with exercises, sets of dumbbells and ankle weights. *(Reference: Nelson et al., 2004)*	**Not reported**	**Moderately effective** 82% of those in the IG exercised 3 times per week for 6 months.	**Moderately effective** Functional performance and balance improved. No difference in 6-minute walk test.	The compliance in this study was high (82%) suggesting that home-based exercise interventions may be effective in increasing levels of PA and associated benefits in older adults. The older adults received 6 visits during the first month, and 1 per month thereafter. Participants also submitted logbooks monthly which could have facilitated compliance.
Community-based strength/ resistance training for older adults - n=39 community dwelling men and women; - 16 weeks. - Aged 72.5 ± 6.3 years ***Activities*** - IG1: Strength training - IG2: Power training: week 1–8 same as IG1, week 9–16 performing exercises as fast as possible. *(Reference: Miszko et al., 2003)*	**Not reported**	**Insufficient evidence** 78% of participants completed the study.	**Promising/insufficient evidence** IG1 and IG2 improved physical functioning (balance and coordination, endurance and upper body flexibility). No significant difference in maximal muscle strength and anaerobic power between IG1 and IG2	IG2's absolute workload was lower than the IG1, but the improvements were greater for physical function. This suggests that more power training may need to be included in PA programmes for seniors.

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
Strength training - Maryland, USA - n=23 community dwelling men and women, aged 65–73 years. - 6 months. ***Activities*** - Months 1–3: 1 x 15 repetitions for lower upper and 2 x 15 repetitions for upper body exercises using resistance training machines - After 3 months: warm up followed by exercises until unable to complete a set of 15 repetitions - Intensity: near maximal effort for each repetition and resistance increased progressively over 6 months. *(Reference: Martel et al. 1999)*	**Not reported**	**Insufficient evidence**	**Promising/insufficient evidence** Upper and lower body strength increased significantly, with men showing greater improvement. Systolic and diastolic blood pressure decreased significantly. No significant changes in BMI.	Strength training on its own can play a role in reducing blood pressure in addition to improving muscle strength. Greater improvements were noted among men, although the small size of this study may affect generalizations.

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
Korean outdoor walking track - Republic of Korea; - 8 weeks. - n=27 community dwelling women ***Activities*** - Outdoor walking track - 50 minutes building up to 3 hours, 3 times per week - 5-minute warm up, 30–40 minutes walking, 10 minutes stretching and 5 minutes cool down. *(Reference: Shin et al. 1999)*	**Not reported**	**Promising/ insufficient evidence**	**Moderately effective** Blood pressure, flexibility and VO2[15] max improved.	PA is not culturally popular among older women of the Republic of Korea, and walking may be a means of encouraging PA in this group.
Tai Chi Chih - California, USA; - 10 weeks. - n=46 community dwellings ***Activities*** - 20 simple movements - One 60-minute group session per week - 3 practice sessions per week at home. *(Reference: Schaller 1996)*	**Not reported**	**Promising/ insufficient evidence** 62% of participants attended at least 6 group-based sessions and practiced at least 3 times per week at home.	**Minimally effective** Balance for 'eyes open' test significantly improved, but not the 'eyes closed' test.	The results of this study may be less easy to generalize since participants were well educated, of high socioeconomic status, physically active and healthy.

[15] VO2 = Volume of Oxygen used

Intervention Components	Psychosocial Changes	Behavioural Changes	Physical and Clinical Changes	Policy/Process Implications
Seniors Active Living in Vulnerable Elders (ALIVE) programme - Alberta, Canada - 10 months. ***Activities*** - Delivered in seniors' apartment buildings - Included exercise classes, health information sessions and newsletters - Qualitative evaluation. *(Reference: Buijs 2003)*	**Promising/insufficient evidence** Qualitative changes in "feeling better", fun, social support, and perceived "comfort in the programme" were noted.	**Not reported**	**Not reported**	
Health promotion programme for low income elderly (Tai-Pai) - Tai Pai, Taiwan, China - 89 purposely selected low income elderly. ***Activities*** - Health promotion programme for low-income elderly provided by trained low-income home health aides. *(Reference: Li 2004)*	**Promising/insufficient evidence** No change was seen in psychosocial status, decreased perceived need for health promotion services.	**Not reported**	**Promising/ insufficient evidence** Improved nutritional status and independent activities of daily living were both noted.	

Source: World Health Organisation. 2009. Interventions on diet and physical activity – what works? (70)

9 Appendix 3: Examples of physical environment modification approaches that can be carried out by local government

Strategy	Tools	Measures/Examples/Comment
Modification through land use allocation		
Create activity destinations	Planning scheme including: • DEO's[16] • Strategies • Land Use Zones	Ensure land use allocation and "land use mix" places residential, commercial, industrial, recreational and other trip generating land uses within walking or cycling distance from each other.
Increased land parcels allocated to recreational land use	• Corporate plan/budget • Capital works program • Designation of Community Infrastructure • Planning scheme	The more and the higher the density of land parcels dedicated to active recreation, the more opportunities to be physically active.
Protect land for food production	Planning scheme including: • DEO's • Strategies • Land Use Zones	Need to reflect State Planning Policy 1/92: *Development and Conservation of A*gricultural *Land* in planning schemes.
Optimise accessibility to healthy food	Planning scheme including: • DEO's • Strategies • Land Use Zones	Distance to supermarkets and local stores influence the variety and competitive pricing of healthy foods.
Minimise accessibility to unhealthy food	Planning scheme including: • DEO's • Strategies • Planning Scheme Policies • Tables of assessment and Codes	The higher the density of fast food outlets, particularly around schools, the higher the consumption of energy dense, nutrient poor foods.
Support initiatives to change individual lifestyle behaviours	• Corporate plan/budget • Capital works program • Designation of Community Infrastructure • Planning scheme	Allocate, designate and purchase land for Council programs and community groups.
Modification through Urban Design at the site/building level		
Prevent crime and increase actual and perceived levels of personal safety	Planning scheme including: • DEO's • Strategies • Planning Scheme Policies • Tables of assessment and Codes	Measures that requires appropriate: levels of lighting; building orientation and setbacks; landscaping, including vegetation and; surveillance
Plan and develop	• Corporate plan/budget	Includes the provision of sport fields,

[16] DEO = Desired environmental outcome

Strategy	Tools	Measures/Examples/Comment
"landscape" and outdoors recreational infrastructure and facilities	• Capital works program • Planning scheme including: - DEO's - Strategies - Planning Scheme Policies - Tables of assessment and Codes - Priority Infrastructure Plans	walking paths and bicycle ways in parks and reserves.
Plan and develop indoors recreational facilities	• Corporate plan/budget • Capital works program • Planning scheme including: - DEO's - Strategies - Planning Scheme Policies - Tables of assessment and Codes - Priority Infrastructure Plan.	Includes provision of aqua centres, squash and basketball courts, gymnasiums in buildings designated for public and private use (such as an on-site gym for use by employees).
Provide appropriate embellishments i.e. play equipment, benches and water fountains	• Corporate plan/budget • Capital works program • Planning scheme, particularly the Priority Infrastructure Plan.	Includes play equipment, BBQ facilities, benches, water fountains and toilets/change rooms.
Maintenance of parks and gardens	• Corporate plan/budget • Capital works program	Enhance the aesthetic values of the building or site.
Provide or regulate for the provision of public and employer amenities that support physical activity and healthy eating	• Corporate plan/budget • Capital works program • Planning scheme, particularly: Planning Scheme Policies; Tables of assessment and Codes; and Priority Infrastructure Plans	Includes areas for breast feeding and end-of-trip facilities such as bicycle lock-ups and changing facilities.
Establish local community gardens, school gardens, home gardens and edible landscapes	• Corporate plan and budget • Capital works program	Provide fresh produce with potential educational, social and nutritional benefits.

Strategy	Tools	Measures/Examples/Comment
Modification through Urban Design at the street level		
Prevent crime and increase actual and perceived levels of personal safety	• Planning scheme including: - DEO's - Strategies - Planning Scheme Policies - Tables of assessment and Codes	Measures that requires appropriate: levels of lighting; building orientation and setbacks; landscaping, including vegetation and; surveillance
Enhance the aesthetic values of the streetscape	• Corporate plan/budget • Capital works program • Planning scheme, particularly Desired Standards of Service in Priority Infrastructure Plans	Landscaping and embellishments such as bus shelters, sculptures, benches and other street furniture.
Modification through Community /Neighbourhood Urban Design		
Ensure a high level of neighbourhood connectivity	• Planning scheme including: - DEO's - Strategies - Planning Scheme Policies - Tables of assessment and Codes	A high level of interconnectivity of transport infrastructure such as sidewalks (including dedicated walkways) and cycle lanes (including dedicated cycle ways) reduces the time and physical distance between destinations and encourages the use of active transport.
Increase densities	Planning scheme including: - DEO's - Strategies - Planning Scheme Policies - Tables of assessment and Codes	Higher densities increase the number of residential and commercial premises in an area. This has the effect of increasing the number of persons with access to recreational and transport activity infrastructure, retail outlets such as supermarkets, public transport and other facilities that support physical activity and healthy eating. High levels of usage, in turn increases the viability and level of service provided by these facilities and infrastructure.
Transportation		
Optimise linkages between individual buildings and sites and public transport facilities and active	• Planning scheme, particularly: Planning Scheme Policies, tables of assessment and Codes.	Provide ready access to bus stops and walk and cycle ways.

Strategy	Tools	Measures/Examples/Comment
transport infrastructure		
Integrate active transport infrastructure and recreation facilities in major mixed use developments	• Planning scheme, particularly: Planning Scheme Policies, tables of Assessment and Codes.	Provide for separation of motorised vehicles and pedestrians and provide cycle ways and parks in business parks and regional shopping centres.
Provide active transport infrastructure	• Corporate plan and budget • Capital works program • Planning scheme, particularly: Planning Scheme Policies and Priority Infrastructure Plans	Primarily side-walks and cycle ways. Can be shared (pedestrians/vehicles and cyclists sharing the same reserve) or dedicated infrastructure.
Encourage the use of active transport infrastructure	• Corporate plan and budget • Capital works program • Planning scheme, particularly Desired Standards of Service in Priority Infrastructure Plans	Measures include kerb type, traffic management and control devices, street crossings and crossing aides, verge width, driveway crossovers to aid continuity, vehicular and cycle lane markings and adequate sighting distances.
Encourage public transport and discourage motorised transport	• Corporate plan and budget • Local Laws • Designation of Community Infrastructure • Planning scheme including: - DEO's - Strategies - Planning Scheme Policies - Tables of assessment and Codes - Priority Infrastructure Plans	Measures include imposing neighbourhood parking restrictions and providing park-and-ride facilities close to public transport.

Source: Pretorius. 2008.The Supportive Environments for Physical Activity and Health Project, Phase One: Options Paper. (69)